

Sustainable Himalayan May apple export from the Nepalese Himalayan region

Deron Caplan

AGR*2150 F14

Introduction

The Himalayan May apple, *Podophyllum hexandrum* Royle, is a perennial herb native to the lower elevations of Himalayan countries [1][7]. The rhizomes contain high amounts of podophyllotoxin, an active ingredient in at least 7 drugs currently marketed in Canada [5]. In the Himalayan countries in which this plant is found, which including Nepal, where the plant is known as Laghu patra [7], unsustainable harvesting from the wild has created the need for cultivation [1][5]. The high value of this crop and Canadian demand for podophyllotoxin [5] presents an income subsidizing opportunity for Nepalese subsistence farmers.

Himalayan May apple information and benefits to Nepal

Current practice

Himalayan May apple is entirely collected from the wild [1][5]. Throughout the world, including in Nepal, there is little active to no active cultivation of this plant. Qazi (2011) argues that relying completely on wild collection of medicinal plants has several problems. Over-exploitation can lead to dramatic declines in plant populations and wild plants have an undesirable variance in levels of active ingredient [1][6]. In the case of the Himalayan May apple, over-exploitation has resulted in its current listing as endangered under IUCN criteria [1][2].

Grazing, due to increased livestock densities, and the increased international demand for medicinal plants, have been identified as the two most significant factors leading to reduced Himalayan May apple numbers [2]. There is currently no system in place to control the collection or regeneration of medicinal plants in Nepal [7]. Supporting the cultivation of the Himalayan May apple can provide livelihoods for farmers of Nepal as well protect this threatened species.

In India, the primary producer of Himalayan May apple, wild harvesting is currently illegal under the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) [1]. Only cultivated or artificially propagated plants can be exported, with the requirement of a CITES export permit and certificate of cultivation [1]. Wild harvest is not illegal in Nepal which makes harvesting planting material for cultivation easier [1].

Cultivation in Nepal

Very little literature exists on the large scale cultivation of the Himalayan May apple because, as discussed in the section above, it has been almost exclusively collected from the wild [1][5]. This means that smaller scale cultivation and propagation techniques [3] need to be scaled up to bring greater economic benefits for Nepalese farmers.

The Himalayan May apple grows optimally on the lower slopes of the Himalayas [3]. Loamy soils, rich in organic matter, and high altitude are ideal for cultivation; these conditions are well met by Himalayan moist sub-alpine meadows of Nepal [2]. These regions are also favorable due to relatively lower levels of human pressure related to grazing and relatively high levels of resource availability in terms of rainfall and soil nutrients [2].

Propagation can be successful from seed or through splitting of the plant's rhizome, although at high elevations, rhizome cuttings are a preferable starting material [3]. Rhizome cuttings (2-2.5 cm) should be planted in late April or May, spaced 30 cm apart and irrigated three to four times per growing season [3][6]. It takes upwards of five years until rhizomes and roots can be harvested, ideally in May for highest podophyllotoxin content [3].

Because wild harvesting is still legal in Nepal and this plant is relatively abundant in sub-alpine meadows [2], sourcing of planting materials should not prove difficult. In order to ensure a sustainable source of planting material, a percentage of the harvested rhizomes would need to be replanted based on the 30% success rate of rooting rhizomes [4]. Rooting success rate could be increased to up to 70% if treated with the rooting hormone IBA before planting [4].

Harvested rhizomes must be washed, sun-dried and further dried on a wire netting, three feet above a fire [4]. Estimated yields from the above process could range from 330 to 490 kg/acre [3].

Limitations on cultivation

Due to the lack of literature on Himalayan May apple cultivation, information on pests, diseases and weeding requirements is unavailable. Further research in these areas would be essential for successful large scale cultivation.

It is suspected that lack of cultivation expertise [7] will be a limiting factor in the production of this crop. Due to the low rate of literacy among subsistence farmers [9], illustrated cultivation guides could provide a useful tool to begin this practice.

Another potential issue is crop destruction through grazing, to which this species is very susceptible [2]. A potential solution includes fencing off fields; this however adds additional costs to farmers. Furthermore, the 5 year crop maturation period [3] would make it difficult to use this crop as a source of primary income due to a lag between planting and payment.

Potential benefits for Nepali subsistence farmers

In the Himalayan region that is suggested for May apple cultivation, the large majority of inhabitants are small-scale subsistence farmers [2]. The ideal locations for cultivation, moist sub-alpine meadows, are sparsely populated and the land is largely uncultivated [2]. This represents large areas of land for farmers to cultivate without having to displace other members of the community. The simple methods of cultivation described in the above section require few farming implements and little maintenance [3] making them ideal for Nepalese subsistence farmers.

Rhizomes contain up to 15% podophyllotoxin [10], meaning over 70 kg of extract could be produced per acre cultivated [3]. The value of this crop is difficult to determine because of barriers to international trade [1] and lack of cultivation [5]. The high demand [1] and market price [5], as outlined in the final section of this paper, indicates that exporting dried rhizomes could create a significant amount of income for Nepalese farmers.

Potential for export to Canada

Podophyllotoxin is used in the synthesis of at least seven drugs marketed in Canada including three FDA approved anticancer drugs: etoposide, teniposide and etophos [10]. It is also an active ingredient in products for therapy of genital warts [6][10]. Currently, podophyllotoxin is completely sourced from the wild collection of American May apple and, to a lesser degree, imported Himalayan May apple. This is because organic synthesis is not yet economically feasible [1][5].

While Himalayan May apple is scarcer than its North American relative, due to historical over-exploitation, it contains 2-4 times more podophyllotoxin which makes it a highly desirable podophyllotoxin source [6][10].

Although already produced in India on a small scale, international demand is still significantly higher than supply [1]. There is a 100 tonne annual demand of Himalayan May apple from international sources, with only 50-80 tonnes of this being met [2]. In addition, Agriculture and Agri-Food Canada (2012) estimates that in 1990, the international market for drugs of both American and Himalayan May apple was worth in excess of \$100 million CAD [5].

Sanofi-Aventis Canada Inc. produces the podophyllotoxin-based genital wart drug Condyline [8] and may be interested in importing Nepali raw ingredients. Podophyllotoxin is also commonly used in traditional Ayurvedic medicine for treating conditions such as venereal warts and *Taenia capitis*, a fungal infection of the scalp [6]. Potential Canadian importers of this product are listed in **Table 1** in the appendix.

References

1. Chaurasia, O., & Ballabh, B. (2012). Podophyllum L: An endangered and anticancerous medicinal plant—An overview. *Indian Journal Traditional of Traditional Knowledge*, 11, 234–241. <http://nopr.niscair.res.in/handle/123456789/13851>

11/18/2014

2. Ghimire, S. K., Mckey, D., & Aumeeruddy-Thomas, Y. (2006). Himalayan medicinal plant diversity in an ecologically complex high altitude anthropogenic landscape, Dolpo, Nepal. *Environmental Conservation*, 33, 1. doi:10.1017/S0376892906002943
3. Hameed, I., Ullah, A., Murad, W., & Khan, S. (2014). *Podophyllum hexandrum* Royle, 4(6), 331–338.
4. Nadeem, M., Palni, L. M. S., Purohit, A. N., Pandey, H., & Nandi, S. K. (2000). Propagation and conservation of *Podophyllum hexandrum* Royle: an important medicinal herb. *Biological Conservation*, 92, 121–129. doi:10.1016/S0006-3207(99)00059-2
5. *Podophyllum peltatum* L. (May-apple). Agriculture and Agri-Food Canada (AAFC). (2012). <http://www.agr.gc.ca/eng/science-and-innovation/science-publications-and-resources/resources/canadian-medicinal-crops/medicinal-crops/podophyllum-peltatum-l-may-apple/?id=1301436227464>
6. Qazi, P., Rashid, A., & Shawl, S. (2011). “*Podophyllum hexandrum*” - a versatile medicinal plant. *International Journal of Pharmaceutical Sciences*, 3(5). http://www.researchgate.net/publication/235344704_podophyllum_hexandrum_a_verseatile_medicinal_plant
7. Rawal, D. S., Sijapati, J., Rana, N., Rana, P., Giri, A., & Shrestha, S. (2009). Some high value medicinal plants of Khumbu region Nepal, 10, 73–82.
8. Sanofi-aventis. (2012). *Product monograph: Condyline*.
9. Sharma, T. N. (1999). The role of technical education and vocational training in the broader perspective of Nepal’s employment and training system. *Southern Illinois University at Carbondale*.
10. Sharma, V. (2013). Part based HPLC-PDA quantification of podophyllotoxin in populations of *Podophyllum hexandrum* Royle “ Indian Mayapple ” from higher altitude Himalayas. *Journal of Medicinal Plants Studies*, 1, 176–183.

Appendix

Table 1. Contact list of potential Canadian importers of Nepalese podophyllotoxin

Potential Importer	Podophyllotoxin use	Phone Number	Email Contact	Website
Sanofi-aventis Canada Inc.	Possible interest in more potent podophyllotoxin source for their genital wart drug, Condyline.	(514) 956-6200	See “contact” page on website	www.sanofi.ca
Purity Life Health Product	Canada’s largest distributor of natural health products. May have interest is Podophyllotoxin for Ayurvedic medicine.	(519) 853-3511	info@puritylife.com	www.puritylife.com
Corwin Distribution Limited	Canadian distributor of natural health products. Carry many brands of Ayurvedic medicine which could import Podophyllotoxin.	Bonnie Cooper, Purchasing & Marketing Manager 1-800-464-5116 x228	bonnie@corwindistribution.com	www.corwindistribution.ca
Puresource, Natural Products Distributor	Canadian distributor of natural health products carrying Ayurvedic medicine. Potential to carry Podophyllotoxin resin.	Angele Gilbert 800-265-7245 x8832	angele.gilbert@puresource.ca	www.puresource.ca